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THE SCIENCE OF TIMBER VALUATION

By James D. Lacey & Co.,

Timber Land Factors: Chicago, Seattle, Portland, New Orleans.

The investor in timber, for either a long term hold or immediate conversion into lumber, or the investor in bonds, secured by standing timber and operating plants, is entitled to receive the same intelligent report on the amount of raw material, its availability, quality, adaptability for logging and operating that a prospective purchaser of a coal field, irrigation project, water power or mine would expect to obtain. Many well known names of mining, water power and coal experts are almost household words in our own country, and abroad as well; while irrigation and water power engineers equipped by special study and training to prepare reports and estimates on projects requiring an expenditure of millions of dollars, are eagerly sought by investors in, and promotors of, such enterprises.

The layman who invests in a mine, in a water-power, irrigation project or coal field, does so because of his confidence in the ability, commercial standing and integrity of the specialist who has reported on the property under consideration. The bank, trust company, bond house or small investor, who buys the stock or bonds of such enterprises, has not the time or the facility to make a personal verification of the facts laid before them in advance of the securities going before the investing public; hence they are compelled to rely to a very great extent upon the reporting expert in each particular and specialized line. In the case of securities offered for sale by banks, trust companies and bond houses, the funds usually flow from a clientele who have implicit confidence in the judgment and integrity of the institution making the offering, and likewise the financial institutions and bond houses must employ the services of experts of recognized standing in their vocations for the purpose of examining the properties presently to be utilized as security. Obviously these experts should always be of the highest integrity, possessed of great experience, and in whose judgment the investor has the utmost confidence.

This bond of confidence being established between the fiscal agent, representing the maker of the bonds, and the expert who passes on the security behind the bonds, on the one part, and the investor on the other part, it follows that the result is almost invariably satisfactory, in that the securities are handled at a fair measure of profit, and the buyers of them are satisfied with their investment, because of their faith both in the value of the security itself and the means adopted to determine it.

Our house was established almost thirty-five years ago by the present senior member of our firm, and during that period we have specialized in timber, timber securities and the correlated industries to the exclusion of everything else. In the first instance our attention was turned to the south at a time when entire townships of vacant government land were purchasable at one dollar and twenty-five cents per acre, and when it was generally supposed that the white pine of Michigan and Wisconsin had passed the speculative period of its history. Early in the decade of 1890, our activities centered in demonstrating the merits of cypress as a utility and specialty wood, and much of our time was devoted to collaboration with the patentees and pioneer manufacturers of the mechanical devices used in logging cypress, that have since played so vital a part in the amazing advance in its stumpage value.

The decade inaugurated by the year 1900 showed great advances in the stumpage value of yellow pine, cypress and all hardwoods throughout the country, while in the lake states the price of white pine stumpage became elevated to such a point that it could only be purchased as an adjunct to a manufacturing plant, erected for the purpose of immediate operation. During this decade the attention of lumbermen, capitalists and others was directed toward the forests of the Pacific northwest and British Columbia. The same decade witnessed investments, generally on the part of lumbermen, in tracts of high grade sugar pine in California and southern Oregon, or the utility woods of the northwest; notably fir, spruce, cedar and hemlock, which in the previous decade were not actively in demand. Dating from that same year, woods that had enjoyed no established commercial stumpage value, such as cottonwood, gum, and in many localities, hemlock, received their first recognition, and it was during this decade that timber bond issues were evolved and quickly took their place among the leading popular securities sought by the investor at a time of unprecedented prosperity in all lines of industry in America and, except in isolated instances, throughout the older nations of the world.

This flow of prosperity continued with one or two minor setbacks until the financial disturbance of 1907 was precipitated upon the country. From 1900 until the present time timber bond issues amounting to millions of dollars have been successfully marketed at par, and occasionally premiums have been paid for the bonds of certain institutions.

The foregoing preface to the general paper which will follow, gives a brief resumé of timber conditions and timber bonds since 1890, and in passing, it is worthy of note that with one or two exceptions the makers of the bonds have met all obligations of principal and interest at maturity, without default; and that in no instance known to us have the expert's reports on the security back of the bonds themselves been found other than as represented.

In the earlier days of timber land investments when values were low and the basis of valuation was usually the public domain offered in bulk at the government price of one dollar and twenty-five cents per acre, or the entryman's "claim," necessity for careful determination of the volume of timber on a given acre was not known. It was then sufficient that the purchaser or his representative should go over the ground superficially and satisfy himself that the area under consideration was timbered. If all the factors which made for value were satisfactory, the purchase was concluded and the owner rested contentedly in the knowledge that he was early on the ground and that he had secured the best.

With increased stumpage values and the investment of large sums of money by capitalists and lumbermen who were attracted to the field by the profits earned through such speculations, came a demand for more detailed reports, particularly from investors who were not lumbermen or who were not possessed of the knowledge of timber values. Then came the development of professional "timber cruising" and "cruisers."

Beginning in the days when the white pine forests of Michigan, Wisconsin and Minnesota, and the virgin yellow pine and cypress forests of the gulf states, stretched away into the unknown, and men, alone or in pairs, disappeared beyond the limits of civilization, the evolution of the timber cruiser has continued down to the present time. In those days "land lookers" went forth to explore and returned after weeks or months to report that on certain waters or in certain townships there were so many acres that would cut so many million feet of lumber. Often these early "land lookers" were unable to prepare figures or written reports. Their calculations were carried in their heads from day to day and week to week.

Then there gradually came into use various methods by which averages of the stand of timber on any given acreage were obtained, and more correct reports were turned in by cruisers. That certain sections would cruise about so many thousand feet per acre, with scant additional information concerning topography, streams, etc., was about the substance of such returns. This approximation was occasionally supplemented by some meager information about the logging conditions, and a brief description of the general location of the timber. As has been pointed out eventually the eyes of eastern lumbermen and capitalists were turned toward the forests of the Pacific Coast, both in the United States and British Columbia.

It is well known that the great commercial yellow pine forests of the south consist of open woods, usually free from underbrush of sufficient density to impede vision. The cypress is found in only commercial quantity in certain sections of Louisiana, Florida, Georgia and North and South Carolina; almost always in close proximity to the Gulf of Mexico, the Atlantic Ocean and bordering the sluggish bayous near their coasts. The southern hardwoods are more widely distributed, and owing to the mixed stand of timber are more difficult to estimate than either yellow pine or cypress, for in the latter type cypress constitutes the principal forest stand, and the cruiser's attention is not diverted to multiplicity of species. It has only been within the past few years that tupelo gum, the under-forest of cypress, has been taken into account in cruising.

The same element of technical skill in estimating that is now employed on the Pacific Coast would be superfluous in most estimating contracts in the south, due to the uniformity of species and stand of timber in the southern forests, and especially due to the absence of serious topographical obstacles that would bear upon the economies of logging. It is true that in many of the southern states, even apart from the Appalachian and Ozark ranges, and their foothills, localities exist where the nature of the ground would tend to greatly increase the cost of logging, in comparison with timber on the so-called "flat woods" or on slightly rolling ground, but broadly speaking, the commercial forests of the south stand upon ground highly favorable for economical logging. The technical text of this paper will relate chiefly to methods adopted by us in the west, including British Columbia, Washington, Oregon, California and the states embraced in the inter-mountain region. When conditions are encountered in the south similar to those existing in any of the above mentioned localities, the same methods of procedure that we follow in the west can be put in practical operation.

At the time we entered the western field we put in use a system of cruising which involved an actual tree count on a given number of strips—usually two or four, across each forty acre subdivision or "forty." Our cruisers attempted to count and classify the trees on strips a "half-tally" (62 paces, or 55 yards) in width on either side of compass lines followed by the estimators. This innovation was viewed unfavorably by those who still clung to the past. Although even such a system in the light of the present was comparatively primitive, time and the methods in vogue among practically all western estimators to-day have proven that it was a step in the right direction. But the errors found in such work, due in part to the heavy undergrowth in most western forests, compelled modifications in this system as our experience increased, until the method followed by us at this time was developed.

Nor was it sufficient that the system alone of cruising should be developed. In addition the problem of finding men of sufficient intelligence and education to adapt themselves to the changing conditions was no easy one. However, the inevitable evolution has continued, until to-day it is no uncommon thing to find throughout the west expert timber cruisers who are graduates not only of the forest schools of recognized standing, but of many of the leading eastern universities. They are not men of theory alone, as some might suppose. They have gone into the timber as loggers, packers, clerks or compassmen. They have lived the life and done the work of the woods; they have endured the hardships and privations of the remote wildernesses of British Columbia and suffered the trials incident to cruising in the Sierras, at a high altitude during the rigors of winter. After such apprenticeship they have emerged woodsmen with trained minds and an ability to tell what they have seen, in addition to an expert knowledge of timber and timber values. Men of such intelligence and of proven integrity have done much to make timber cruising a profession in the true meaning of the word. Their skill and their conscientious efforts have not only won the confidence of their employers, but added greatly to the safety of investors in timber securities who risk annually millions of dollars upon the honesty and sound judgment of timber estimators.

To establish uniformity in estimating and enable any competent cruiser to determine the contents of trees with accuracy, volume tables were compiled to show the number of feet, board measure, of lumber contained in trees of different diameters, heights and forms, according to adopted log scales. From time to time these tables have been perfected in detail in order to meet the exacting demands made upon them.

To insure regard for rules laid down to govern the work of our men on particular tracts and under particular conditions, head cruisers are selected because of their wide experience in all lines of timber work, unquestionable integrity and sound judgment. Upon these men is placed the responsibility not only of directing the work, but of checking the estimates turned in to them by their crews. Having a tract of timber to cruise after the most accurate manner practicable in consideration of cost, we first send an expert woodsman, preferably the head cruiser who will be in charge, over the tract to fix upon a general plan of operations and prepare a preliminary report on the character of the timber. This report is the basis of the instructions issued to the cruisers. Survey crews are then sent to the tract to locate the corners and lines, established perhaps many years before by government surveyors, and to survey and plainly mark out the minor subdivisions; also to set "tally stakes" for the guidance of the cruiser's compassmen.

When this work is well under way the cruisers are sent in and the actual estimating of the timber begins. As has been suggested, the head cruiser in charge has familiarized himself with the lay of the land and the general conditions which are to be encountered. He has, as it were, planned the campaign; he has decided upon the approximate location of his camps; he has arranged all the numerous details which insure the smoothness, the economy and the effectiveness of the contract.

As in all work, men demonstrate special adaptability along certain lines, so it is with cruising. With a knowledge of each man's individual fitness for work in varying kinds of timber and under different conditions, the head cruiser gives to each a separate assignment.

Assume, for the sake of clearness, that camp has been established near the corner of sections 23, 24, 25 and 26. "A" has been assigned to estimate the east half of section 23. "B" is his compassman. Before leaving camp the two men look well to their equipment. "A" makes sure that he has his tape—generally a fifty foot steel diameter tape—his volume table, his small celluloid pad, his pencils, his tally registers used in counting the trees, and his hand-axe, which he uses freely in sounding the timber, ascertaining the thickness of the bark and chopping into the wood to study its texture and the thickness of the sap. Meanwhile "B" has set his aneroid barometer at the known camp elevation and adjusted the vernier of his staff compass to the variation established by the surveyors for the lines on Section 23. He takes his Jacob's staff, his celluloid pad and his pencils.

The two men make sure of their location at the southeast corner of Section 23. The surveyors have previously subdivided the section and set the tally stakes 62 paces, or one-half tally, apart on the north and south boundaries of the section and on the one-quarter line running east and west. As this is to be an eight-run tree count cruise, the estimator taking all merchantable timber included within a strip 31 paces on either side of his compass line, the first stake must necessarily have been set 31 paces west of the east boundary of the section and numbered in consequence "tally one-quarter west." The second stake being 62 paces, or one-half tally, further west would be numbered tally three-quarters west, or "T ¾ W" for brevity.

It is obvious, therefore, that "A" and "B" must work the section north and south. That is, their first run will begin at "T ¼ W" on the south line of the section and they will proceed northward on their compass line, checking the width of their strip and the variation of their compass needle on similarly marked stakes on the one-quarter line and the north boundary of the section.

Arriving at the north line, they will set over 62 paces to the west to "T ¾ W" and in a similar manner carry their line southward. In this way they will traverse the section back and forth, a mile one way, set over to the next stake and return a mile. This two-mile run, which completes the estimate upon forty acres, constitutes an average day's work under ordinary Pacific Coast conditions. It may, in fact, be regarded almost as a minimum, for the men cover from three to five miles depending upon the density of the timber, if the ground is smooth and free from brush. Only under the most unfavorable circumstances does a cruiser fail to make a report upon less than two miles. Strip by strip not only this entire half section, but in the same manner the whole tract is ultimately worked. Every tree is counted and estimated according to its individual value, the character and quality of each species in each locality is carefully recorded; each topographical feature; the natural outlet for each group of lands; each ascent or descent of one hundred feet in elevation is noted as accurately as is possible from barometric readings and all is permanently transcribed.

But we are getting ahead of our story. We left cruiser and compassman at T ¼ W on the south line of the section.

Before "A" actually begins the work of estimating the timber, to make sure that he has judged correctly the width of his strip, he has his compassman measure off 31 paces, or 82½ feet, on each side of the compass line. This is most important and is frequently repeated as the work progresses, as a check upon the accuracy of the estimator's eye. It is astonishing the degree of accuracy an expert cruiser attains in judging distances.

Next the cruiser "sizes up" his timber. He endeavors first to find windfalls of each species, which are representative types. If this is possible he measures the down tree with his tape. He ascertains the exact butt diameter, having chopped away the bark, and the diameter of each succeeding 32-foot or 16-foot log according to the basis of the estimate. By this method he is able to compute from the standard log scale the exact volume of the tree, taking it log for log, the average taper and the number of merchantable logs it contains. He uses these fallen trees as a standard of comparison by which to judge of the contents, the height and the taper of those standing. His experience has taught him that trees of approximately the same age, growing under the same conditions, will attain to approximately the same height, and will maintain the same volume and taper. It is vital to the accuracy of his work that the cruiser keep careful watch on the changing age, conditions and types of the timber through which he passes in the course of a day's work. Unconsciously he expects to find the tall clean timber in the draws or on well protected benches; while on the poorer exposures his woodsmanship prompts him to look for the shorter and more imperfect specimens. In a country notoriously free from windfalls, as is frequently the case in the western pine, the estimator often carries some one of the numerous mechanical devices designed to determine the height of standing timber. His steel tape is always in use as an aid and a check to his trained eye in arriving at the butt diameters. Experience has made the expert cruiser a good judge of taper—given him the ability to see at a glance whether a tree holds its size well up into the branches or whether it tapers off rapidly and fails to contain the amount of lumber that its butt diameter would indicate.

Years of practice have imprinted indelibly on the mind's eye of the competent cruiser certain forms and types and sizes, which to him represent certain known contents, and subconsciously these form standards of comparison upon which he bases his estimate upon given trees. By frequent reference to his volume table he has come to know, for example, that a tree 24 inches in butt diameter, containing three 32-foot logs with an average taper of 4 inches to the log—will cut 1,000 feet board measure, also that a tree 31 inches in diameter, four logs high, with a 5-inch taper contains 2,000 feet. Such standard trees, it must be remembered, are simply an index upon which to work, a rule of thumb, as it were, to systematize and simplify the work of the estimator and to add both speed and accuracy to his efforts. In other words, they serve to standardize his judgment. Should he find trees defective or malformed, he must deduct accordingly. Further, should he find trees that are seriously affected by fungi or any similarly serious diseases peculiar to certain species, he disregards them entirely. Often such trees will cut considerable good lumber, but the failure to include them in the estimate will be offset by hidden defect in some of the timber estimated. One approximately equalizes the other.

After the estimator has gotten a sufficiently good line upon the different species of timber in which he is working, he slowly follows his compassman across the allotted "run," working back and forth among the trees, counting, measuring, estimating, always keeping in mind the width of his strip. He places his figures for each species, tally by tally, upon his celluloid pad, makes mental and frequent manual note of the logging conditions, the fire risk, the soil—in fact, each and all of the many features that bear directly upon the value of a tract. Consequently, when he has completed his work upon a given section he can write an intelligent report upon what he has seen.

One of the most modern and essential ramifications of the profession of estimating timber, and the one upon which we lay particular stress, is the correct grading of the various species. Our cruisers are instructed to use the greatest care in this part of the work and the results of their efforts along this line are closely checked by the head cruiser. The importance of this branch of cruising is at once obvious when it is known, for example, that in the Pacific northwest a difference in the grades of logs means a difference of from three to six dollars per thousand feet board measure on the open market. In other words, a tract of high quality timber is conservatively worth from three to six dollars per thousand feet, when its products are marketed, more than a tract of poorer quality. Pursuing the argument, it is apparent that paying a good price for good quality standing timber is a more profitable investment than paying a slightly less price for a tract that will only cut out the commoner grades.

In estimating, therefore, the cruiser must keep a vigilant eye to the quality of the timber through which he passes. It will not do for him to simply report that the "fir is of fair quality." He must tell, as nearly as it is possible to tell, just how much per cent of No. 1, how much No. 2 and how much No. 3 the fir will cut. He must be guided by the grading rules in force for each species in the market to which the output from the particular tract will eventually go. And to this end he has a very tangible system by which to arrive at his conclusions. As suggested, he must be familiar with the grading rules which apply, in average trees of each species he must carefully note the number of logs which will go into each grade, and then by referring to the modern volume table which our men are required to use, he can see just what per cent each log bears to the entire contents of a tree of given dimensions.

However expert and conscientious "A" may be, the results of his efforts alone are not accepted as final. It is one of the duties of the head cruiser on a contract of this kind to keep a careful check upon the work of each of the men in his crew. The aim is always to have upon any one piece of work not more than five cruisers at most. With a crew of this size the head cruiser can make frequent runs over ground previously estimated by the different men. He compares his figures, the tree count, the volume, the grades, and the general notes, with the results turned in by "A," for example. Should there be a discrepancy between the two estimates of more than ten per cent, "A" is required to recruise his former work. Should there still be an equally serious variance, either in tree count or volume, "A" and the head cruiser go over the same ground together in the most careful manner. If necessary, trees are felled and measured when down, in order to settle disputes. Finally, if "A" cannot or will not be convinced that he is evidently in error, the superior experience and the tested judgment of the head cruiser must hold. "A" must retire.

The work of "B" the compassman, aside from the running of compass-lines, pacing and assisting "A" in measuring the timber, consists in taking the topography and gathering the data necessary for the building of a complete map of the tract. Equipped as he is with an aneroid barometer, he records upon his pad the elevation at every tally, and as his work progresses, he joins by a line, known as a contour line, all like elevations representing an ascent or descent of one hundred feet. Water courses, the outlines of burns, openings or brush patches; the location of buildings, logging works; in fact, all features of interest to the tract are marked upon his miniature map. The daily notes of each compassman comprise the units which are later combined into a topographic picture.

With the record of their day's work on their pads, cruiser and compassman return to camp, where during the evening their original work is transcribed by the clerk. Exact copies of the figures of each cruiser upon each tally are put in permanent form, in duplicate. Each cruiser writes his notes and grades also upon permanent blanks and in duplicate. The originals of these reports are forwarded to our district offices, the duplicates being preserved by the clerk in camp to guard against possible loss in the transmission of the originals.

Likewise the topography from the celluloid pads of the compassman is drawn by the clerk upon a working map. As this map grows and large areas of it are completed, they also are forwarded to the offices.

As the work from the field comes in it is classified, checked and re-checked by the office force. The cruisers' figures are totaled and detailed reports covering each section by forties are prepared, showing the number of trees of each species, their average length, average contents, total volume, and percentage of each grade. The logging situation, character of each species of timber, fire risk and a general description of the conditions surrounding the particular section in question, are gone into at length.

Complete maps are compiled from the original field notes of the surveyors, showing the exact acreage of each section or subdivision and defining any irregularities that may exist in the official government survey. Such acreage maps are supplemented by contour maps based upon the original notes of the compassmen taken in the field. A glance at one of these maps makes clear the drainage and the principal divides; a careful study reveals the natural outlets for the logs, the most feasible routes for rail and skid roads, the smaller leads and gulches, the approximate degree of the slopes, the well timbered areas and the openings.

Possessed of the detailed reports of the estimates, the acreage and the contour maps, and in addition, a general report by the head cruiser in charge, covering the availability of the tract, an analysis of the timber and the conditions surrounding it, the logging chance treated broadly, and a description of any existing improvements upon or in the immediate vicinity of the lands; possessed of all this information, the local representative sets about to prepare a report in the name of the company dealing definitely with the values of the property under consideration. Frequently he must personally gather first-hand knowledge of matters which bear directly upon the tract and which by their very nature cannot be covered by the cruiser's reports. Familiar as he is with the conditions which make for value, in the territory in which he is accustomed to operate, he is competent to dwell with authority upon the worth of each species of timber shown in the estimates, taking into consideration its quality, its accessibility and the markets which await its ultimate cutting. He can hazard a shrewd guess at the approximate value of the land after the timber has been removed; he can make a close estimate of the working value of whatever logging equipment may be on the premises, and he can venture a description of mills, and in fact, any other improvements of value that may be allied with the timbered holdings. In these days of varied and complicated operations, however, it is obviously the work of appraisal and audit companies, supported by mechanical experts, to fix upon correct valuations and earning capacities.

With all this fund of information laid before the man of capital, information gathered by a corps of men in the field, each an expert in his line, whose integrity has been proven: figures, maps, reports—it matters not whether this capitalist be a lumberman or a banker or a merchant. He has something definite and tangible upon which to base his decision.

He is not simply told that "the area under consideration is timbered," or that "on certain waters there are so many acres that will cut so many million feet of lumber." The actual facts and figures and maps are before him in detail. They tell the story, whether it pertains to timber north, south, east, or west, and with as much pertinency to spruce in Quebec as to redwood in California, cypress and yellow pine in the south, to hemlock and hardwood in the lake states.

In conclusion, we wish to point out that numerous factors other than immediate local conditions must be taken into consideration by the investor in timber or timber securities. Obviously the laws of supply and demand as related to production of raw material are important. Wood is the product of years of growth, and our existing laws and public policies have not yet been developed to a degree which lends encouragement to the production of timber as a crop. We must, therefore, investor and security holder alike, place our reliance to a great extent upon a rapidly diminishing visible supply, the ultimate value of which will be limited only by relative values as between wood and wood substitutes.

In a paper as concise as this, it is impossible to touch upon every head bearing upon the value of timber, and the methods employed to establish it, but it must be borne in mind that the increase of stumpage values may be properly compared to the increase of realty values in and about populous centers. In the beginning the land is farmed; then it is subdivided into acreage, and eventually into town lots, the value of which increases as the demands of society bring about more intensive occupation. It follows then, in the case of timber holdings, that the investor should have in mind a well-defined purpose when such an investment is selected. Timber available for immediate demand has greater value than has that which is remote and which will not be used until years have passed. All of it will eventually be required, and an increase in value is absolutely certain, yet the same factors which make for value and profit at this time will bear upon future values and profits, possibly to an increased degree.

Inside business property has a more or less fixed, realizable value at all times, while outlaying acreage is dependent in a great measure upon the ebb and flow of prosperity; and the same rule applies to timber, though the future demand for the latter is much more certain.

Availability and quality are, and will be, therefore, the governing factors in stumpage values; yet the investor in timber, or bonds secured by timber, should not lose sight of the factor of adaptability as related to species. And with these potent qualities should be combined another important consideration, namely, the volume of visible supply.

As an illustration, it may be pointed out that the diminuation of the hardwood supply of the United States is causing concern among manufacturers. Canada now draws upon us more heavily from year to year; there is no western hardwood to fill the need; future supplies must come from the Orient, or undeveloped foreign countries, such as South America. The once abundant white pine of our northern states is practically extinct. In Idaho there is a comparatively small area covered with a similar species, the value of which has already ascended to five dollars per thousand feet where railroad development has made it available. Every million feet of yellow pine cut from the forests of the southern states brings us closer to the yellow pine forests of the inter-mountain region; every day's issue of newspapers marks an advance toward the spruce and hemlock of the northwest, and so on through the entire list of species.

The supply cannot increase; the world's demand upon our forests cannot decrease. This briefly is a certainty to which students of economics will give thoughtful consideration.